

DETAILED ACTION

1. Claims 1-24 are presented for examination.

Claim Objections

2. Claims 7, 15 and 17 are objected to because of the following informalities:

- i. As per claim 7: Line 4: There appears to be an error at "can not". This shall be amended to read -- cannot --.

- ii. As per claim 15: Line 5: There appears to be an error at "can not". This shall be amended to read -- cannot --.

- iii. As per claim 17: Line 12: There appears to be an error at "can not". This shall be amended to read -- cannot --.

Appropriate correction is required.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

3. **Claims 1-7, 9-15, 17-18 and 20-23 are rejected under 35 U.S.C. 102(b) as being anticipated by Cota-Robles et al. (US 2002/0143842; hereinafter Cota-Robles).**

4. As per claim 1, Cota-Robles teaches a method, comprising

- determining that a device related operation happens in a virtual machine by a kernel component of a virtual machine monitor through an operation transition from the virtual machine to the kernel component, wherein the device related operation includes an operation inputting/outputting data to/from an input/output device (*paragraph 29, lines 1-12; paragraph 32, lines 1-10; paragraph 37, lines 1-4; paragraph 38, lines 1-12; trap to VMM when main VM attempts to read/write to hardware device*); and
- determining whether virtualization of the device related operation can be handled by a first virtual input/output device installed inside of the kernel component of the virtual machine monitor (*paragraph 32, lines 1-10; paragraph 37, lines 1-4; paragraph 38, lines 1-12; VMM uses virtual network interface card to ensure soft device, located in dedicated VM, corresponding to hardware device is available for use by main VM, i.e., requested I/O operation cannot be handled by VMM and must be forwarded to dedicated VM*).

5. As per claim 2, Cota-Robles teaches the method of claim 1, wherein the first virtual input/output device comprises at least one of a virtual keyboard, virtual mouse, virtual audio device, virtual video device, and a virtual network card (*paragraph 32, lines 6-10; virtual network interface card*).
6. As per claim 3, Cota-Robles teaches the method of claim 1, and Cota-Robles further teaches the virtual machine monitor is a hybrid virtual machine monitor (*paragraph 31, lines 1-4; paragraph 32, lines 1-6; VMM where some functions are offloaded to dedicated VM*).
7. As per claim 4, Cota-Robles teaches the method of claim 3, and wherein the kernel component is a hypervisor of the hybrid virtual machine monitor (*paragraph 19, lines 3-9; VMM exports bare machine to virtual machines*).
8. As per claim 5, Cota-Robles teaches the method of claim 1, wherein the virtual machine monitor is a host virtual machine monitor (*paragraph 21, lines 1-4; paragraph 31, lines 1-4; paragraph 32, lines 1-6; paragraph 30, lines 6-12; VMM used in conjunction with host OS*).

9. As per claim 6, Cota-Robles teaches the method of claim 5, wherein the kernel component is a kernel virtual machine monitor (*paragraph 19, lines 3-9; VMM exports bare machine to virtual machines*).

10. As per claim 7, Cota-Robles teaches the method of claim 1, further comprising: passing the device related operation to a second virtual input/output device installed outside of the kernel component of the virtual machine monitor, in response to determining that the virtualization of the device related operation cannot be handled by the first virtual input/output device (*paragraph 29, lines 1-12; paragraph 32, lines 1-10; paragraph 37, lines 1-4; paragraph 38, lines 1-12; VMM redirects I/O acceses by main VM to dedicated VM, which uses soft device therein to perform requested operations*).

11. As per claim 9, it recites a system having limitation similar to those of claim 1 and is rejected on the same basis. Cota-Robles further teaches a system comprising:

- a processor (*paragraph 16, lines 13-15; processors*); and
- a virtual machine monitor coupled to the processor (*paragraph 16, lines 13-15; paragraph 19, lines 3-4; processor executing VMM*).

12. As per claim 10, it recites a system having limitation similar to those of claim 2 and is rejected on the same basis.

13. As per claim 11, it recites a system having limitation similar to those of claim 3 and is rejected on the same basis.

14. As per claim 12, it recites a system having limitation similar to those of claim 4 and is rejected on the same basis.

15. As per claim 13, it recites a system having limitation similar to those of claim 5 and is rejected on the same basis.

16. As per claim 14, Cota-Robles teaches the system of claim 13, wherein the kernel component is a kernel virtual machine monitor of a host operating system (*paragraph 21, lines 1-4; paragraph 31, lines 1-4; paragraph 32, lines 1-6; paragraph 30, lines 6-12; VMM used in conjunction with host OS*).

17. As per claim 15, it recites a system having limitation similar to those of claim 7 and is rejected on the same basis.

18. As per claim 17, Cota-Robles teaches a tangible computer-readable medium comprising a plurality of instructions which when executed result in an apparatus (*column 16, lines 1-7; executable instructions stored on computer-readable medium*):

- determining that a device related operation happens in a virtual machine by a kernel component of a virtual machine monitor through an operation transition from the

virtual machine to the kernel component, wherein the device related operation includes an operation inputting/outputting data to/from an input/output device (*paragraph 29, lines 1-12; paragraph 32, lines 1-10; paragraph 37, lines 1-4; paragraph 38, lines 1-12; trap to VMM when main VM attempts to read/write to hardware device*);

- determining whether virtualization of the device related operation can be handled by a first virtual input/output device installed inside of the kernel component of the virtual machine monitor (*paragraph 32, lines 1-10; paragraph 37, lines 1-4; paragraph 38, lines 1-12; VMM uses virtual network interface card to ensure soft device, located in dedicated VM, corresponding to hardware device is available for use by main VM, i.e., requested I/O operation cannot be handled by VMM and must be forwarded to dedicated VM*); and
- passing the device related operation to a second virtual hardware input/output device installed outside of the kernel component of the virtual machine monitor, in response to determining that the virtualization of the device related operation cannot be handled by the first virtual hardware device (*paragraph 29, lines 1-12; paragraph 32, lines 1-10; paragraph 37, lines 1-4; paragraph 38, lines 1-12; VMM redirects I/O accesses by main VM to dedicated VM, which uses soft device therein to perform requested operations*).

19. As per claim 18, it recites a medium having limitation similar to those of claim 2 and is rejected on the same basis.

20. As per claim 20, it recites a medium having limitation similar to those of claim 3 and is rejected on the same basis.

21. As per claim 21, it recites a medium having limitation similar to those of claim 4 and is rejected on the same basis.

22. As per claim 22, it recites a medium having limitation similar to those of claim 5 and is rejected on the same basis.

23. As per claim 23, it recites a medium having limitation similar to those of claim 6 and is rejected on the same basis.

24. Claims 1-24 are rejected under 35 U.S.C. 102(e) as being anticipated by Anderson et al. (US 7,757,231; hereinafter Anderson).

The applied reference has a common assignee with the instant application. Based upon the earlier effective U.S. filing date of the reference, it constitutes prior art under 35 U.S.C. 102(e). This rejection under 35 U.S.C. 102(e) might be overcome either by a showing under 37 CFR 1.132 that any invention disclosed but not claimed in the reference was derived from the inventor of this application and is thus not the invention "by another," or by an appropriate showing under 37 CFR 1.131.

25. As per claim 1, Anderson teaches a method, comprising

- determining that a device related operation happens in a virtual machine by a kernel component of a virtual machine monitor through an operation transition from the virtual machine to the kernel component (*column 8, lines 22-25; column 10, lines 19-24; transition from guest VM to micro-hypervisor when guest VM requests access to controlled device*),
- wherein the device related operation includes an operation inputting/outputting data to/from an input/output device (*column 7, lines 48-59; column 8, lines 22-25; I/O operation is communication access to I/O device*); and
- determining whether virtualization of the device related operation can be handled by a first virtual input/output device installed inside of the kernel component of the virtual machine monitor (*column 9, lines 41-57; column 10, lines 25-27; determine if device access request is to be handled by device model in micro-hypervisor*).

26. As per claim 2, Anderson teaches the method of claim 1, wherein the first virtual input/output device comprises at least one of a virtual keyboard, virtual mouse, virtual audio device, virtual video device, and a virtual network card (*column 5, lines 44-45; column 9, lines 41-42; device model for network interface card*).

27. As per claim 3, Anderson teaches the method of claim 1, wherein the virtual machine monitor is a hybrid virtual machine monitor (*column 5, lines 7-8; hybrid architecture VMM*).

28. As per claim 4, Anderson teaches the method of claim 1, wherein the kernel component is a hypervisor of the hybrid virtual machine monitor (*column 5; lines 7-8 and 53-54; micro-hypervisor in hybrid architecture VMM*).

29. As per claim 5, Anderson teaches the method of claim 1, wherein the virtual machine monitor is a host virtual machine monitor (*column 5, lines 7-10; hybrid architecture VMM uses elements from host-based VMM architectures*).

30. As per claim 6, Anderson teaches the method of claim 1, wherein the kernel component is a kernel virtual machine monitor (*column 5; lines 53-54; micro-hypervisor*).

31. As per claim 7, Anderson teaches the method of claim 1, further comprising: passing the device related operation to a second virtual input/output device installed outside of the kernel component of the virtual machine monitor, in response to determining that the virtualization of the device related operation cannot be handled by the first virtual input/output device (*column 5, lines 15-16; column 7, lines 22-25; column 8, lines 24-28; column 10, lines 25-27 and 46-48; micro-hypervisor proxies requests to device model(s) in service VM if request cannot be handled by micro-hypervisor*).

32. As per claim 8, Anderson teaches the method of claim 1, further comprising: initiating an interrupt by a third virtual device installed inside of the kernel component of the virtual machine monitor, wherein the third virtual device comprises at least one of a virtual event timer and virtual interrupt controller; and injecting the interrupt from the third virtual device to the virtual machine through another operation transition from the kernel component to the virtual machine (*column 7, lines 5-12; column 9, lines 41-57; column 10, lines 19-30; device model for interrupt controller in micro-hypervisor performs interrupt routing determinations and virtualizes interrupt functionality*).

33. As per claim 9, it recites a system having limitation similar to those of claim 1 and is rejected on the same basis. Anderson further teaches a system comprising:

- a processor (*column 11, line 7; processor*); and
- a virtual machine monitor coupled to the processor (*column 5, lines 7-8; column 11, lines 1-10; hybrid architecture VMM executed by processor*).

34. As per claim 10, it recites a system having limitation similar to those of claim 2 and is rejected on the same basis.

35. As per claim 11, it recites a system having limitation similar to those of claim 3 and is rejected on the same basis.

36. As per claim 12, it recites a system having limitation similar to those of claim 4 and is rejected on the same basis.

37. As per claim 13, it recites a system having limitation similar to those of claim 5 and is rejected on the same basis.

38. As per claim 14, Anderson teaches the system of claim 13, wherein the kernel component is a kernel virtual machine monitor of a host operating system (*column 5 lines 7-10, 53-54 and 63-66; micro-hypervisor in hybrid architecture VMM using elements from host-based VMM architectures, where SVM serves some purpose of host OS*).

39. As per claim 15, it recites a system having limitation similar to those of claim 7 and is rejected on the same basis.

40. As per claim 16, it recites a system having limitation similar to those of claim 8 and is rejected on the same basis.

41. As per claim 17, Anderson teaches a tangible computer-readable medium comprising a plurality of instructions which when executed result in an apparatus (*column 11, lines 35-43; executable instructions stored on computer-readable medium*):

- determining that a device related operation happens in a virtual machine by a kernel component of a virtual machine monitor through an operation transition from the virtual machine to the kernel component (*column 8, lines 22-25; column 10, lines 19-24; transition from guest VM to micro-hypervisor when guest VM requests access to controlled device*),
- wherein the device related operation includes an operation inputting/outputting data to/from an input/output device (*column 7, lines 48-59; column 8, lines 22-25; I/O operation is communication access to I/O device*);
- determining whether virtualization of the device related operation can be handled by a first virtual input/output device installed inside of the kernel component of the virtual machine monitor (*column 9, lines 41-57; column 10, lines 25-27; determine if device access request is to be handled by device model in micro-hypervisor*); and
- passing the device related operation to a second virtual hardware input/output device installed outside of the kernel component of the virtual machine monitor, in response to determining that the virtualization of the device related operation cannot be handled by the first virtual hardware device (*column 5, lines 15-16; column 7, lines 22-25; column 8, lines 24-28; column 10, lines 25-27 and 46-48; micro-hypervisor proxies requests to device model(s) in service VM if request cannot be handled by micro-hypervisor*).

42. As per claim 18, it recites a medium having limitation similar to those of claim 2 and is rejected on the same basis.

43. As per claim 19, it recites a medium having limitation similar to those of claim 2 and is rejected on the same basis.

44. As per claim 20, it recites a medium having limitation similar to those of claim 3 and is rejected on the same basis.

45. As per claim 21, it recites a medium having limitation similar to those of claim 4 and is rejected on the same basis.

46. As per claim 22, it recites a medium having limitation similar to those of claim 5 and is rejected on the same basis.

47. As per claim 23, it recites a medium having limitation similar to those of claim 6 and is rejected on the same basis.

48. As per claim 24, it recites a medium having limitation similar to those of claim 8 and is rejected on the same basis.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

49. Claims 8, 16, 19 and 24 are rejected under 35 U.S.C. 103(a) as being unpatentable over Cota-Robles.

50. As per claim 8, Cota-Robles teaches the method of claim 1, but does not expressly recite initiating an interrupt by a third virtual device installed inside of the kernel component of the virtual machine monitor, wherein the third virtual device comprises at least one of a virtual event timer and virtual interrupt controller; and injecting the interrupt from the third virtual device to the virtual machine through another operation transition from the kernel component to the virtual machine.

It would have been obvious to one of ordinary skill in the art at the time the invention was made for initiating an interrupt by a third virtual device installed inside of the kernel component of the virtual machine monitor, wherein the third virtual device comprises at least one of a virtual event timer and virtual interrupt controller; and injecting the interrupt from the third virtual device to the virtual machine through another operation transition from the kernel component to the virtual machine because Cota-Robles teaches:

The VMM 112 then traps a... software interrupt that occurs under predefined conditions in the dedicated virtual machine 608 and reflects each such... software interrupt when the predefined conditions hold as an interrupt of the appropriate IRQ to the virtualized Programmable Interrupt Controller (PIC of the main virtual machine 606. (*paragraph 42, lines 19-27*).

In other words, the VMM performs interrupt arbitration between the main VM and the dedicated VM. Accordingly, it would have been obvious for initiating an interrupt and injecting the interrupt in the main virtual machine by a virtual interrupt controller in the VMM due to the VMM forwarding an interrupt to the main VM. It would have been further obvious for an operation transition from the VMM to the main VM also due to the VMM forwarding an interrupt to the main VM.

One of ordinary skill in the art at the time the invention was made would have been motivated to do this to "emulate the functionality of a fixed function hardware device without loss of generality" (*paragraph 30, lines 3-4*). This would have been beneficial to enable "a soft device to be accessed from a wide variety of host OSes, including host OSes for which no appropriate soft device drivers exist on the market" (*paragraph 30, lines 7-10*).

51. As per claim 16, it recites a system having limitation similar to those of claim 8 and is rejected on the same basis.

52. As per claim 19, Cota-Robles teaches the medium of claim 17, but does not expressly recite the second virtual hardware input/output device comprises at least one of a virtual keyboard, virtual mouse, virtual audio device, virtual video device and a virtual network card.

It would have been obvious to one of ordinary skill in the art at the time the invention was made for the second virtual hardware input/output device comprises at

least one of a virtual keyboard, virtual mouse, virtual audio device, virtual video device and a virtual network card because Cota-Robles teaches "Residual fixed function hardware 652 could be a PCI card, a USB device, or any other standard peripheral device" (*paragraph 48, lines 8-10*). Accordingly, it would have been obvious for the soft device in dedicated VM to emulate any of a keyboard, mouse, audio device or video device because the enumerated devices are well-known to be standard peripheral devices.

The motivation to do this is the same as stated in the rejection of claim 8.

53. As per claim 24, it recites a medium having limitation similar to those of claim 8 and is rejected on the same basis.

Response to Arguments

54. Applicant's arguments with respect to claims 1-24 have been considered but are moot in view of the new ground(s) of rejection.

Conclusion

55. Any inquiry concerning this communication or earlier communications from the examiner should be directed to BRIAN CHEW whose telephone number is (571)270-5571. The examiner can normally be reached on Monday-Thursday, 8:00AM-5:00PM EST.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Meng-Ai An can be reached on (571)272-3756. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/B. C./
Examiner, Art Unit 2195

/Meng-Ai An/
Supervisory Patent Examiner, Art Unit 2195